CLAIMS

What is claimed is:

Claim 1 - A power generation system featuring enhanced efficiency through the inclusion of a reheat heat exchanger, comprising in combination:

a high temperature high pressure source of working fluid;

a reheat heat exchanger having a high pressure inlet downstream from said high temperature high pressure source of working fluid, a high pressure outlet, a low pressure inlet, a low pressure outlet, a high pressure path between said high pressure inlet and said high pressure outlet and a low pressure path between said low pressure inlet and said low pressure outlet, said high pressure path located in heat transfer relationship with said low pressure path;

an expander having an inlet downstream from said high pressure outlet and a discharge, said expander adapted to expand the working fluid therein from a higher pressure to a lower pressure; and

said discharge of said expander upstream from said low pressure inlet of said reheat heat exchanger.

Claim 2 - The power generation system of Claim 1 wherein a temperature of the working fluid at said high pressure inlet of said reheat heat exchanger is greater than a maximum inlet temperature for said expander.

Claim 3 - The power generation system of Claim 2 wherein a temperature of the working fluid at said high pressure outlet of said reheat heat exchanger is less than or equal to a maximum inlet temperature for said first expander.

Claim 4 - The power generation system of Claim 1 wherein a second expander is located downstream from said low pressure outlet of said reheat heat exchanger.

Claim 5 - The power generation system of Claim 4 wherein said source of working fluid is a source of a mixture of substantially only steam and carbon dioxide.

Claim 6 - The power generation system of Claim 5 wherein a separator is located downstream from said second expander, said separator adapted to separate at least some of the water in the working fluid from at least some of the carbon dioxide in the working fluid.

Claim 7 - The power generation system of Claim 6 wherein said separator includes a condenser having a condensed steam/water outlet and a gaseous carbon dioxide outlet.

Claim 8 - The power generation system of Claim 7 wherein at least a portion of the water at said condenser water outlet is recirculated to said source of working fluid.

Claim 9 - The power generation system of Claim 8 wherein a feed water heater is provided in heat transfer relationship with the working fluid between said discharge of said expander and said separator, said feed water heater adapted to heat the water being recirculated from said steam/water outlet of said condenser to said source of working fluid.

Claim 10 - The power generation system of Claim 8 wherein said source of working fluid includes a combustor having an oxygen inlet, a hydrocarbon fuel inlet and a water inlet, said water inlet located downstream from said water outlet of said condenser, said combustor adapted to combust the oxygen with the hydrocarbon fuel to create the working fluid of substantially only steam and carbon dioxide.

Claim 11 - The power generation system of Claim 1 wherein said source of working fluid includes a combustor having an oxygen inlet, a hydrocarbon fuel inlet and a water inlet, said combustor adapted to combust the oxygen with the hydrocarbon fuel to produce the working fluid of substantially only steam and carbon dioxide, said combustor adapted to mix the water from said water inlet with the combustion products produced within said combustor.

Claim 12 - The power generation system of Claim 1 wherein said reheat heat exchanger includes a casing through which said low pressure inlet and said low pressure

outlet pass, said casing including a pair of tube sheets with tubes passing between said pair of tube sheets, interiors of said tubes accessing said high pressure inlet and said high pressure outlet with said tube interiors defining at least a portion of said high pressure path; and

at least one baffle within said casing and between said low pressure inlet and said low pressure outlet, said baffle configured to increase a length of said low pressure path between said low pressure inlet and said low pressure outlet.

Claim 13 - The power generation system of Claim 1 wherein a temperature drop between said high pressure inlet and said high pressure outlet is at least about 500°F.

Claim 14 - The power generation system of Claim 1 wherein said reheat heat exchanger has a temperature change of substantially 500°F between said high pressure inlet and said high pressure outlet.

Claim 15 - The power generation system of Claim 1 wherein said high pressure inlet receives the working fluid at a pressure of at least about 1500 psi.

Claim 16 - The power generation system of Claim 1 wherein a temperature change of said reheat heat exchanger between said low pressure inlet and said low pressure outlet is between 300°F and 700°F.

Claim 17 - The power generation system of Claim 16 wherein a temperature change between said low pressure inlet and said low pressure outlet is between about 450°F and about 500°F.

Claim 18 - The power generation system of Claim 1 wherein a pressure of said low pressure path is between about 150 and about 180 psi.

Claim 19 - A method for enhancing efficiency of a power generation system having a high temperature high pressure source of a working fluid, a first working fluid expander and a second working fluid expander downstream from the first working fluid expander, the method including the steps of:

providing a reheat heat exchanger having a high pressure inlet, a high pressure outlet, a low pressure inlet, a low pressure outlet, a high pressure path between the high pressure inlet and the high pressure outlet, and a low pressure path between the low pressure inlet and the low pressure outlet, the high pressure path located in heat transfer relationship with the low pressure path; and

locating the reheat heat exchanger with the high pressure inlet downstream from the source of high temperature high pressure working fluid, the high pressure outlet upstream from the first working fluid expander, said low pressure inlet located downstream from a discharge of the first working fluid expander, and the low pressure outlet located upstream from the second working fluid expander.

Claim 20 - The method of Claim 19 including the further step of matching a temperature of the working fluid at the high pressure outlet of the reheat heat exchanger substantially with a maximum inlet temperature for the first expander.

Claim 21 - The method of Claim 19 including the further step of matching a temperature of the working fluid at the low pressure outlet of the reheat heat exchanger substantially with a maximum inlet temperature for the second working fluid expander.

Claim 22 - The method of Claim 19 including the further step of separating the working fluid into separate constituents including at least water and carbon dioxide downstream from the second expander.

Claim 23 - The method of Claim 22 including the further step of recirculating at least a portion of the water separated by said separating step back to the source of high temperature high pressure working fluid.

Claim 24 - The method of Claim 23 including the further step of heating at least a portion of the water during said recirculating step by passing the recirculated water in heat transfer relationship with the working fluid between the discharge of the first expander and a point of separation of the working fluid downstream from the second working fluid expander.

Claim 25 - The method of Claim 22 including the further step of sequestering at least a portion of the carbon dioxide separated by said separating step by pressurizing the carbon dioxide to at least a pressure within a terrestrial formation selected for sequestration of the carbon dioxide and delivering the pressurized carbon dioxide into the terrestrial formation.

Claim 26 - A reheat heat exchanger comprising in combination:

a casing;

a pair of tube sheets interfacing with said casing;

a plurality of tubes extending between said tube sheets;

a high pressure inlet located adjacent at least one of said tube sheets;

a high pressure outlet located adjacent at least one of said tube sheets and opposite said high pressure inlet;

a high pressure path extending between said high pressure inlet and said high pressure outlet, said high pressure path defined at least partially by interiors of said tubes;

a low pressure inlet passing through said casing;

a low pressure outlet passing through said casing; and

a low pressure path extending between said low pressure inlet and said low pressure outlet and in contact with an exterior surface of said tubes.

Claim 27 - The reheat heat exchanger of Claim 26 wherein a plurality of baffles are located within said casing and between said low pressure inlet and said low pressure outlet, said baffles configured to lengthen said low pressure path between said low pressure inlet and said low pressure outlet.

Claim 28 - The reheat heat exchanger of Claim 26 wherein a first expander is located downstream from said high pressure outlet, said first expander including a discharge located upstream from said low pressure inlet.

Claim 29 - The reheat heat exchanger of Claim 28 wherein a second expander is provided downstream from said low pressure outlet.

Claim 30 - The reheat heat exchanger of Claim 29 wherein a recirculation pathway is provided between a location downstream from said second expander and a location upstream from said high pressure inlet.

Claim 31 - The reheat heat exchanger of Claim 26 wherein surfaces of said reheat heat exchanger are adapted to handle a working fluid including substantially only steam and carbon dioxide at temperatures greater than 1000°F.

Claim 32 - The reheat heat exchanger of Claim 26 wherein surfaces of said reheat heat exchanger are adapted to handle a working fluid including substantially only steam and carbon dioxide at temperatures of at least about 1500°F.